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NEW PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Sir:

Transmitted herewith for filing is the patent application of Inventor: Jon Ebbe Brelin

Title: **METHOD OF AND APPARATUS FOR COMMUNICATING DATA STRUCTURES BETWEEN DEVICES IN A NETWORKING ENVIRONMENT**

CERTIFICATION UNDER 37 CFR § 1.10

I hereby certify that this New Application and the documents referred to as enclosed herein are being deposited with the United States Postal Service on this date, June 30, 2000, in an envelope bearing "Express Mail Post Office To Addressee" Mailing Label Number EL055724233US addressed to: **PATENT APPLICATION**, Assistant Commissioner for Patents, Washington, D.C. 20231.

Carleen O'Brien
(Name of Person Mailing Paper)

Signature

Enclosed are:

1 The papers required for filing date under CFR § 1.53(b):

30 Pages of Specification (including claims); 10 Sheet(s) of Drawings.

Formal
Informal

2 ☒ Declaration or Oath (combined with Power of Attorney) Unexecuted3 ☒ Power of Attorney (combined with Declaration) Unexecuted4 ☐ Assignment of the Invention to Sony Corporation and Sony Electronics, Inc. (including Form PTO-1595).

5 Fee Calculation

☐ Amendment changing number of claims or deleting multiple dependencies is enclosed.

CLAIMS AS FILED

	Number Filed	Number Extra	Rate	Basic Fee
				\$690.00
Total Claims	32 - 20 =	12	\$18.00	216.00
Independent Claims	3 - 3 =	0	\$78.00	0.00
Multiple Dependent claim(s), if any			\$260.00	
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6. Other Fees

☐ Assignment Recordation Fee☐ Other

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7. Payment of Fees

☒ Check in the amount of \$906.00 enclosed.8. ☒ Authorization to Charge Additional Fees

The Commissioner is hereby authorized to charge any additional fees (or credit any overpayment) associated with this communication and which may be required under 37 CFR § 1.16 or § 1.17 to Account No 08-1275. **An originally executed duplicate of this transmittal is enclosed for this purpose.**

9. ☒ Return Receipt PostcardDated: June 30, 2000

By:

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PATENT
Attorney Docket No. SONY-13800

**METHOD OF AND APPARATUS FOR COMMUNICATING DATA
STRUCTURES BETWEEN DEVICES IN A NETWORKING ENVIRONMENT**

Field of the Invention:

5 The present invention relates to an architecture, a system and a method for communicating data structures between networked devices. More specifically, this invention relates to an architecture, system and method for communicating data structures between devices that are networked with an IEEE 1394 serial bus

10 Background of the Invention:

15 The IEEE standard, "IEEE Std 1394-1995 Standard For A High Performance Serial Bus," is an international standard for implementing an inexpensive high-speed serial bus architecture which supports both asynchronous and isochronous format data transfers. Isochronous data transfers are real-time transfers which take place such that the time intervals between significant instances have the same duration at both the transmitting and receiving applications. Each packet of data transferred isochronously is transferred in its own time period. An example of an ideal application for the transfer of data isochronously would be from a video recorder to a television set. The video recorder records images and sounds and saves the data in discrete chunks or packets. The video recorder then transfers each packet, representing the image and sound recorded over a limited time period, during that time period, for display by the television set. The IEEE 1394-1995 serial bus architecture provides multiple channels for isochronous data transfer between applications. A six bit channel number is broadcast with the data to ensure reception by the appropriate application. This allows multiple applications to

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simultaneously transmit isochronous data across the bus structure. Asynchronous transfers are traditional data transfer operations which take place as soon as possible and transfer an amount of data from a source to a destination.

The IEEE 1394-1995 standard provides a high-speed serial bus for
5 interconnecting digital devices thereby providing a universal I/O connection. The IEEE
1394-1995 standard defines a digital interface for the applications thereby eliminating the
need for an application to convert digital data to analog data before it is transmitted
across the bus. Correspondingly, a receiving application will receive digital data from the
bus, not analog data, and will therefore not be required to convert analog data to digital
10 data. The cable required by the IEEE 1394-1995 standard is very thin in size compared
to other bulkier cables used to connect such devices. Devices can be added and removed
from an IEEE 1394-1995 bus while the bus is active. If a device is so added or removed
the bus will then automatically reconfigure itself for transmitting data between the then
existing nodes. A node is considered a logical entity with a unique address on the bus
15 structure. Each node provides an identification ROM, a standardized set of control
registers and its own address space. Because of these advantages, the IEEE 1394-1995
standard provides for a unique networking structure that is capable of incorporating
audio/video devices, media play/record devices and computing/display devices.

A diverse range of products can be implemented with the ability to connect to an
20 IEEE 1394-1995 serial bus network. These devices can have capabilities and
functionality ranging from very simple to very complex. Specifically, a variety of
audio/video devices, media play/record devices and computing/display devices are
capable of being linked together over an IEEE 1394-1995 serial bus networking structure
to support asynchronous and isochronous data transfers between the devices.

The IEEE 1394-1995 serial bus allows a collection of devices to work together in a high bandwidth, distributed environment to maximize the overall efficiency and functionality of the network. This allows manufacturers to remove expensive pieces of functionality from one device and locate that functionality in another device on the network, instead of duplicating this functionality in all devices on the network. While some of the devices have limited functionality and are relatively inexpensive, such devices require the support and interaction of other devices in order to bring the full functionality of the devices within the network to the user.

The AV/C Digital Interface Command Set is a command set used for data transactions between consumer audio/video equipment over an IEEE 1394-1995 serial bus. Neither the IEEE 1394-1995 serial bus nor the AV/C command set provide a master-slave relationship between the devices coupled within the IEEE 1394-1995 serial bus network. Instead, both the IEEE 1394-1995 serial bus and the AV/C command set operate based on a cooperative peer-to-peer coexistence of devices within the network. Discrete AV/C command and response data packets are transferred between networked devices over an IEEE 1394-1995 serial bus in an asynchronous data stream. The AV/C command and response data packets are typically formatted according to the AV/C protocol outlined in the AV/C Digital Interface Command Set. Transfers of AV/C command and response data packets over the IEEE 1394-1995 serial bus network are supported by an AV/C architecture. The AV/C architecture is comprised of lists and tables that help devices create, process and/or transmit AV/C command and response data packets. The AV/C architecture includes an AV/C bulletin board subunit that is typically dedicated to a resource device subunit such as a tuner, receiver or recoding unit.

An AV/C bulletin board subunit is an information structure that is shared between devices networked over an IEEE 1394-1995 serial bus network. A resource schedule bulletin board is also an information structure that supports information shared between coupled devices within a network. The resource schedule bulletin board provides the organizational structure through which shared data is organized and communicated. The resource schedule bulletin board contains sub-boards of lists with entry descriptors that represent encoded data that can be shared between devices within the network via descriptor commands. A dedicated AV/C bulletin board subunit typically supports the information architecture between that device and all compatible posting devices within an IEEE 1394-1995 serial bus network. A posting device writes a request entry to a write enabled list within the resource schedule bulletin board specifying when it will use the resource.

Neither the IEEE 1394-1995 serial bus nor the AV/C Command Set provide a master-slave relationship between the devices coupled within the IEEE 1394-1995 serial bus network. Instead, both the IEEE 1394-1995 serial bus and the AV/C Command Set operate based on the cooperative peer-to-peer coexistence of devices within the network transmitting data formatted in accordance with the AV/C protocol. The communicating devices exchange command and response data directly with each other without the intervention of a systems resource manager. Each device or device subunit is responsible for managing scheduling affairs and storing resource requests.

Within the current AV/C protocol, resource time of a resource device is made available to any requesting control device. Within this protocol a device competing for use of a resource device can acquire the right to use the resource device by reserving the resource device, even though another client device may have previously submitted an

entry to the resource schedule board requesting the resource device at the same time. Devices may modify or delete data contained within the schedule entries submitted by other requesting control devices without acknowledging to the other requesting control devices that their respective schedule entries are being or have been modified. Thus, within the current AV/C protocol there is no method to allow control devices within a network to monitor schedule data or to provide a peer-to-peer review of schedule modifications.

SUMMARY OF THE INVENTION:

The method of and apparatus for communicating data structures between devices in a networking environment of the present invention is an architecture, a method and a system for monitoring data structures written to and stored in a descriptor mechanism. The invention is particularly useful for monitoring data structures submitted to a bulletin board subunit from networked control devices. Preferably, the control devices are networked together with an IEEE 1394-1995 serial bus network and the bulletin board subunit is an AV/C resource bulletin board subunit that is dedicated to a resource device, such as a VCR or other audio video device. The data structures are preferably resource schedule entries, or portions thereof, posted to acquire resource time from a resource subunit of the resource device.

Each schedule entry stored to the AV/C resource bulletin board subunit specifies the node address of the requesting control device, the resource subunit that is being requested and the time or times that the resource is being scheduled. According to the current invention, schedule entries are monitored for access activity after being stored to the AV/C resource schedule bulletin board subunit by an original requesting control

device. In the event that the schedule entry is accessed by a competing control device after it has been stored to the resource schedule bulletin board, a notify response is sent to the node address of the original requesting control device which notifies the original requesting control device that the schedule entry has been accessed by the competing control device.

Preferably, the original requesting control device specifies the data structure or data structures within the schedule entry that are to be monitored. The original requesting control device specifies the data structures that are monitored by providing a corresponding notify command with the schedule entry when the resource request is submitted to the AV/C resource schedule bulletin board. However, it is considered to be within the scope of the invention that the original requesting control device also submits notify commands to the resource schedule bulletin board at any time that schedule entries are stored in the AV/C resource schedule bulletin board subunit of the resource device. It is also preferable that requesting control devices specify the type of access activity that is to be monitored. For example, when a requesting control device submits a write notify command with a schedule entry, then the schedule entry is monitored for write access activity by competing control devices. In the event that a competing control device writes data or deletes portions of the specified data structure within the schedule entry, then a write notify response is sent to the node address of the requesting control device.

Similarly, when a requesting control device submits a read notify command with a schedule entry, then the schedule entry is monitored for read access activities by competing control devices. In the event that a competing control device reads the specified data structure within the monitored schedule entry, then a read notify response is be sent to the node address of the requesting control device.

According to another embodiment of the present invention, schedule entries are automatically monitored for access activity that is performed by competing control devices. Anytime that a competing control device reads a schedule entry, writes to a schedule entry or otherwise modifies a schedule entry that is stored in the AV/C resource schedule bulletin board subunit, a notify response is sent to the original requesting control device to notify the original requesting control device that the schedule entry has been accessed. The original requesting control device is provided an opportunity to review any modifications made to the schedule entry by the competing control device.

A notify command data frame, according to the present invention, contains a data field that captures the address of a competing device that accesses the specified data field of the monitored schedule entry. Further, the notify command data frame contains a data field that captures portions of the specified data structure accessed by the competing control device and provides codes representative of the access activity performed by the competing device. The data contained within the notify command frame is preferably stored in the memory unit of the AV/C resource bulletin board subunit to provide a detailed history of the schedule entry and access activities relating thereto.

A notify response data frame of the present invention provides an alert message to an original requesting control device when the specified data structure of a monitored schedule entries is accessed by a competing control device. According to an alternative embodiment of the present invention, a notify response command also provides the original requesting control device with information about a competing control device and access activity performed on the monitored schedule entry. Accordingly, notify response data frames contain data fields that post the node address of the competing control device

and portions of the specified data structure accessed or modified by the competing control device.

Brief Description of the Drawings:

5 Figure 1 illustrates a block diagram of an exemplary IEEE 1394-1995 serial bus network including a computer system and a video camera.

 Figure 2 illustrates a block diagram of the internal components of the computer system 10.

10 Figure 3 illustrates a block diagram of a network system within an IEEE 1394-1995 Serial Bus Network according to the present invention.

 Figure 4 shows a control device schedule request and a resource device schedule entry at a target device.

 Figure 5 shows a detailed resource schedule sub-entry.

15 Figure 6 illustrates a block diagram of a system with control devices capable of posting schedule entries to an AV/C bulletin board subunit of a coupled resource device.

 Figure 7a illustrates a requesting control device submitting a schedule entry with a write notify command to an AV/C resource schedule bulletin board subunit according to the present invention.

20 Figure 7b illustrates a competing control deleting a portion of the schedule entry posted by the original requesting control device in Figure 7a.

 Figure 7c illustrates the AV/C resource schedule bulletin board subunit sending a write notify response to the original requesting control device according to the present invention.

Figures 8a-b show write notify command frames submitted to an AV/C resource schedule bulletin board subunit according to the present invention.

Figures 9a-b show read notify command frames submitted to an AV/C resource schedule bulletin board subunit according to the present invention.

Figure 10 illustrates a flow diagram for monitoring a schedule data structure according to the preferred embodiment of the present invention.

Detailed Description of a Preferred Embodiment:

A block diagram of an exemplary IEEE 1394-1995 serial bus network including a computer system and a video camera is illustrated in Figure 1. The computer system **10** includes an associated display **12** and is coupled to the video camera **14** by the IEEE 1394-1995 serial bus cable **16**. Video data and associated data are sent between the video camera **14** and the computer **10** over the IEEE 1394-1995 serial bus cable **16**.

A block diagram of the internal components of the computer system **10** is illustrated in Figure 2. The computer system **10** includes a central processor unit (CPU) **23**, a main memory **21**, a video memory **25**, a mass storage device **24** and an IEEE 1394-1995 interface circuit **19**, all coupled together by a conventional bidirectional system bus **29**. The interface circuit **19** includes the physical interface circuit **17** for sending and receiving communications over the IEEE 1394-1995 serial bus. The physical interface circuit **17** is coupled to the camera **14** over the IEEE 1394-1995 serial bus cable **16**. In the preferred embodiment of the present invention, the interface circuit **19** is implemented on an IEEE 1394-1995 interface card within the computer system **10**. However, it should be apparent to those skilled in the art that the interface circuit **19** can be implemented within the computer system **10** in any other appropriate manner, including building the

interface circuit onto the motherboard itself. The mass storage device **24** may include both fixed and removable media using any one or more of magnetic, optical or magneto-optical storage technology or any other available mass storage technology. The system bus **29** contains an address bus for addressing any portion of the memory **25** and **21**. The system bus **29** also includes a data bus for transferring data between and among the CPU **23**, the main memory **21**, the video memory **25**, the mass storage device **24** and the interface circuit **19**.

The computer system **10** is also coupled to a number of peripheral input and output devices including the keyboard **26**, the mouse **28** and the associated display **12**. The keyboard **26** is coupled to the CPU **23** for allowing a user to input data and control commands into the computer system **10**. A conventional mouse **28** is coupled to the keyboard **26** for manipulating graphic images on the display **12** as a cursor control device.

A port of the video memory **25** is coupled to a video multiplex and shifter circuit **11**, which in turn is coupled to a video amplifier **27**. The video amplifier **27** drives the display **12**. The video multiplex and shifter circuitry **11** and the video amplifier **27** convert pixel data stored in the video memory **25** to raster signals suitable for use by the display **12**.

Figure 3 illustrates a system of devices **30** coupled within an IEEE 1394-1995 serial bus **33** according to the present invention. The video monitoring devices **31** and **35** are audio/video devices and are coupled to a video recording and media playing device **37** by the IEEE 1394-1995 serial bus **33**, as shown. A computing unit **32** is also coupled to the video recording and media playing device **37** by the IEEE 1394-1995 serial bus **33**. When a user enters a scheduling request to the computer system **32**, the computer system

32 transmits appropriate scheduling request information to the resource schedule board maintained by the video recording and media playing device 37. The schedule information is stored in a posted schedule entry in an AV/C resource schedule bulletin board. Figure 3 is illustrative only and there are number of system configurations and a diverse range of devices that can be supported within an IEEE 1394-1995 serial bus to provide point-to-point data stream transmissions. Further, there is no systems limitation that all the devices coupled within the IEEE 1394-1995 serial bus need to be used in order to practice the invention.

Figure 4 illustrates an exemplary network of devices including a posting device 41 and a target device 43. In an embodiment of the invention, resource schedule entries 44, as shown in Figure 4 contain schedule information for resources. Resource request entries are generated from networked client or scheduling devices 41 using any suitable method known in the art, such as a scheduling protocol supplied with a typical VCR device. The resource request entries are used by a target device 43 which includes the bulletin board subunit including a resource schedule board (RSB) 45 to build a resource schedule according to resource times that are allocated to various resource subunits for the requesting networked client devices. In one embodiment of the current invention, the scheduling data and scheduling architecture is transparent to the user and provides information to coordinate data transfer between devices at a systems level. In another embodiment of the current invention scheduling data and resource schedules are accessible to the users over the network. In further embodiments of the invention, viewable scheduling menus and resource schedules are generated by a graphical user interface. A schedule entry is generated by entering schedule data into a scheduling menu and submitting the data as a resource request from the posting device 41 to the target

device **43** over the network. Resource requests for all the requesting client devices are stored in a memory unit at a central location and the graphical user interface generates viewable resource schedules therefrom. The internal data structure and the graphical interface used for supporting the scheduling menus is application and device dependent.

5 Again referring to Figure 4, resource requests are made by entering schedule data including a start time and date, a duration time, repeat information including an interval value and a number of events value, if appropriate, and a resource indicator in the resource request entry box **42**. A resource request containing the scheduling data shown in the box **42** is submitted over the network and transferred to or used to make a new resource schedule entry **44**. The resource schedule board **45** includes one or more entries **44**, each representing a received resource request and specification indicating that the posting device intends to utilize the resource device according to the information specified in the resource schedule entry **44**. In accordance with an alternative embodiment described above, field values in the resource schedule entries **44** are used to provide a graphical user interface with scheduling data needed to generate a resource schedule accessible over the network.

10 Figure 5 illustrates a view **50** of a high level schedule entry section **51** detailing the schedule entries that are input from a posting or scheduling device to provide a complete resource request. The start time is input in the entry block **57**, the duration time is input in the entry block **59**, and resource device information is input in the entry block **58**. The repeat-time sequences are input in the entry blocks **55** and **52**. Only one of the entry blocks **55** and **52** will be used in each entry, as appropriate. The entry block **52** is used for resource schedule entries to be repeated on a weekly basis. The entry block **55** is used for resource schedule entries to be repeated on a specific interval basis.

In order to specify the repeat-time sequence entries, a number of events value and a repeat interval are required. The number of events value can be equal to any appropriate number, including one, and specifies the number of times the entry is to be repeated. The repeat interval is the time between events and can be daily, weekly, monthly or any appropriate interval. For example, in the entry block **52**, intervals such as daily, weekly or monthly are input along with a number in the number_of_events field which specifies the number of events value and represents the number of times that the request is to be executed, and thus defines the overall duration. Also, certain days of the week can be blocked out or not included within the schedule. By blocking out dates within an overall duration, the resource can be more efficiently used by other client devices. For example, a schedule request can contain field values that indicate a resource is needed every day for two weeks except for Tuesday of the second week. Thus, by viewing the resource schedule, other client or scheduling devices can see that the resource is available on that Tuesday and schedule resource time accordingly. It is convenient to provide day selections such as Monday, Thursday etc., as shown in block **52**, wherein when a user schedules the resource for a particular day, the resource will automatically be scheduled for that selected day for the overall duration of the schedule entry.

The entry block **55** shows an entry form used for resource schedule entries to be repeated on a specific interval basis. In the entry line **56** a time interval is input, which is either a regular time interval (such as an hour or a day) or an irregular time interval that does not follow a naturally repeating block of time. On the entry line **54**, the number of events value is input specifying the number of times the resource request is to be executed. For example, if a user inputs a schedule entry with an interval value corresponding to one hour and 20 minutes and a number of events value equal to nine,

then the shared resource will be scheduled for nine one hour and 20 minute intervals, starting at a time specified in the entry block **57**, with a duration as specified in the duration entry block **59**.

The time data fields for resource requests and schedule entries are chosen to reflect appropriate application of the system. For example, when scheduling audio/video equipment for home or entertainment it is typically sufficient to specify the hours, minutes and seconds of the request such as those shown in block **59**. However, there are particular applications where the time data fields need to be expanded to encompass greater or smaller increments of time. For example, an astronomical study of deep space, may require that audio/video equipment be scheduled for very precise periods of time over the course of a year or more. Therefore, the time data fields that are shown in blocks **57** and **59** are only exemplary and it is understood that they can be expanded to encompass any increment of time that is suitable for the application at hand.

Figure 6 illustrates a system **60** with a resource device **63**, two posting control devices **65** and **67** and an AV/C bulletin board subunit **61** according to the present invention. The solid lines **110** and **111** represent lines of content transmission from the resource subunits **62** and **64**, respectively. The dashed lines **112**, **113**, **114** and **115** represent lines of control data transmission from the control devices **65** and **67** and from the resource subunits **62** and **64** to the AV/C resource schedule board subunit **61**. The AV/C resource schedule board subunit **61** has an AV/C bulletin board **66** and a memory/CPU unit **69**, wherein schedule entries and scheduling data is organized and stored. Control devices **65** and **67** submit resource requests **68** and **68'** to the resource schedule bulletin board **66**, where the requests are organized and posted as schedule entries and stored in the memory **69** of the subunit **61**. Organized schedule entries within

the AV/C resource schedule bulletin board provide a resource calendar. Resource time from each of the resource subunits **62** and **64** is allocated to the requesting control devices **65** and **67** according to the resource schedule calendar.

Again referring to Figure 6, the AV/C bulletin board subunit **61** is preferably transparent to the user and the schedule calendar is updated or modified at the systems level. However, it is considered to be within the scope of the present invention that the AV/C bulletin board subunit **61** is supported by a graphical user interface program (not shown) that provides for direct user participation with device scheduling.

Still referring to Figure 6, the resource requests **68** and **68'** submitted by the control client devices **65** and **67** are accompanied with corresponding notify commands. According to a preferred embodiment of the present invention, the notify commands instruct the resource schedule bulletin board subunit **61** to monitor schedule entries posted to the bulletin board **66** and stored in the memory unit **69**.

Figure 7 shows a system with a requesting control device **76** and a competing control device **78**. The requesting control device **76** and the competing control device **78** are both capable of posting schedule entries, such as those illustrated by blocks **72** and **74**, to the resource schedule bulletin board **73**. The bulletin board subunit **73** is preferably an AV/C resource schedule bulletin board subunit that is dedicated to an audio/video resource device, such as described in Figure 6. The bulletin board subunit **73** has a memory unit (not shown) for storing the posted schedule entries **72**, **73** and **75**. Each of the schedule entries **72**, **73** and **75** contain data fields with data that identifies the requesting control device, specifies a resource subunit being scheduled and the time or times that the resource subunit is being requested.

Again referring to Figure 7a, the requesting control device **76** submits a resource request **70** over a network to the bulletin board **71** where the request **70** is posted as the schedule entry **75**. Preferably, the original requesting control device **76** and the competing control device **78** are coupled to the node including the bulletin board subunit **73** by an IEEE 1394-1995 serial bus. According to the present invention, the requesting control device **76** submits a corresponding notify command **77** with the schedule request **70** to the bulletin board subunit **73** instructing the bulletin board subunit **73** to monitor the schedule entry **75** for a specified access activity.

Now referring to Figure 7b, the competing control device **78** accesses the schedule entry **75** and performs an access activity **70'**. The access activity **70'** includes either deleting the schedule entry **75**, reading the schedule entry **75** or otherwise modifying the schedule entry **75**. The bulletin board subunit **73** determines if the access activity **70'** performed by the competing control device **78** is on the same descriptor specified within the notify command **77** submitted by the original requesting device **76**.

Now referring to Figure 7c, if the access activity **70'** performed by the competing control device **78** is on the same descriptor that is specified by the notify command **77**, then the bulletin board subunit **73** sends a response notify command **77'** to the requesting control device **76**. The response notify command **77'** informs the control device **76** that the schedule entry **75** has been accessed by a competing device **78**. According to an embodiment of the present invention, the notify response **77'** provides data that specifies the access activity **70'** performed by the competing control device **78** and identifies the node address of the competing control device **78** within the network.

Again referring to Figure 7a, according to the preferred embodiment of the invention the requesting control device **76** submits a notify command **77** to a bulletin

board subunit 73 concurrently with a corresponding schedule request 70. While it is preferred that the notify command 77 is submitted immediately after the resource request 70, it is considered to be within the scope of the current invention that the notify command 77 is submitted to the bulletin board subunit 73 at any time during the time period that the schedule entry 75 is stored or maintained within the subunit 73.

The write notify command preferably has the following format:

WRITE DESCRIPTOR, ctype=NOTIFY

A read notify command preferably has the following format:

READ DESCRIPTOR, ctype=NOTIFY

As described herein, both the write notify command and the read notify command are submitted to a descriptor mechanism, such as the bulletin board subunit, by an original requesting device. If a competing control device then accesses the specified descriptors, the descriptor mechanism notifies the original requesting device, in response to the write or read notify command.

Schedule entries, such as those described in Figures 4 and 5, contain descriptor data structures and information data structures. Descriptor data structures provide data that specifies the requesting control device or the resource subunit that is being scheduled. The information data structures provide data that specifies the schedule action such as the start time and the duration time. It is preferred that notify commands submitted with schedule requests according to the present invention specify the data structure being monitored within the corresponding schedule entry. Thus, according to the preferred embodiment of the present invention, both the access activity monitored and the data structure monitored are specified by the notify command.

Figure 8a illustrates a write descriptor notify command frame **80** in accordance with the present invention. The command frame **80** is submitted to a bulletin board subunit with a schedule request and instructs the bulletin board subunit to monitor a specified descriptor data field contained within the corresponding schedule entry for write access activity by a competing control device. The descriptor data of the specified descriptor data field is duplicated within the descriptor_specifier data field **81** of the notify command frame **80**. The subfunction data field **83** contains data that encodes for the type of write access activity that was performed on the descriptor data by the competing control device. For example, when descriptor data is changed, replaced, inserted, deleted, partially replaced or any combination thereof, by the competing control device, the subfunction data field **83** within the notify command frame **80** will provide the data that encodes for the activity. The node_ID data field **82** provides identification data of the competing control device that has accessed the specified descriptor data. The data_length data field **84** codes the command frame **80** for a change in the length of the descriptor data within the specified descriptor data field as a result of the write access activity performed by the competing control device and the address data field **79** provides data that codes for the descriptor address where the change occurred.

Figure 8b, illustrates a write information block notify command frame **85** in accordance with the present invention. Similar to the command frame **80**, illustrated in Figure 8a, the command frame **85** is submitted to a bulletin board subunit with a resource request and instructs the bulletin subunit to monitor a specified information data field contained within the corresponding schedule entry for a write access activity by a competing control device. The information data of the specified information data field is duplicated within the info_block_reference_path data field **87** of the notify command

frame **85**. The subfunction data field **89** contains data that encodes for the type of write access activity that was performed on the information data by a competing device. For example, when information data is changed, replaced, inserted, deleted, partially replaced, or any combination thereof, by the competing control device, the subfunction data field **89** will provide the data that encodes for the type of write access activity performed by the competing control device. The node_ID data field **86** provides identification data of the competing control device that accessed the specified information data field. The data_length field **88** codes the command frame **85** for a change in the length of the information data within the specified information data field as a result of the write access activity performed by the competing control device and the address data field **189** provides data that codes for the descriptor address corresponding to the location where the write activity began.

Figure 9a, illustrates a read descriptor notify command frame **90** in accordance with the current invention. The command frame **90** is submitted to a bulletin board subunit and instructs the bulletin subunit to monitor a specified descriptor data field contained within a corresponding schedule entry for read access activity by a competing control device. The descriptor data of the specified descriptor data field is duplicated within the descriptor_specifier data field **91** of the notify command frame **90**. The node_ID data field **93** provides identification data of the competing control device that accessed the specified descriptor data field. The data_length field **92** codes the command frame **90** for the portion of the descriptor data within the specified descriptor data field that was read by the competing control device and the address data field **94** provides the descriptor address corresponding to the starting location of the read activity.

Figure 9b, illustrates a read information block notify command frame **95** in accordance with the current invention. Similar to the command frame **90** illustrated in Figure 9a, the command frame **95** is submitted to a bulletin board subunit along with a resource request and instructs the bulletin board subunit to monitor a specified information data field contained within the corresponding schedule entry for a read access activity performed by a competing control device. The information data of the specified information data field is duplicated within the info_block_reference_path data field **97** of the notify command frame **95**. The node_ID data field **99** provides identification data of the competing control devices that access the specified information data field. The data_length field **96** codes the command frame **95** for the portion of the information data within the information data field that was read by the competing control device and the address data field **98** provides the descriptor address corresponding to the starting location of the read activity.

Figure 10 is a block-flow diagram **200** according to the method of the preferred embodiment of the present invention. In the step **201**, a schedule entry is provided with a control command by an original requesting control device to an AV/C schedule bulletin board subunit. In the step **202**, the original requesting control device then specifies a data field or data block within the schedule entry to be monitored for access activity performed by competing control devices by a notify write or notify read command frame, such as the notify command frames described in Figure 8a-b and Figure 9a-b, which is submitted to the AV/C schedule bulletin board subunit. The data field to be monitored is preferably specified within this notify command frame. It is also preferable that the notify command is submitted immediately after the schedule request is submitted to the bulletin board subunit. In the step **203**, the bulletin board subunit monitors the specified

data field within the schedule entry until after the first change to the descriptor. When a competing control device accesses the schedule entry in the step **205**, then in the step **207** the bulletin board subunit determines if the competing device has accessed the specified data field in the manner for which the entry is being monitored. If the bulletin board subunit determines that the specified data field has not been accessed, then the bulletin board subunit returns to the step **203** and the bulletin board subunit continues to monitor the specified data field. If, at the step **207** the bulletin board subunit determines that a competing device has accessed the specified data field, then in the step **209** access data is stored to the subunit memory and the access activity is posted to the notify command frame. Preferably, the access data includes the node address of the competing device and the data that has been accessed. The bulletin board subunit then determines, at the step **211**, if the access activity matches the command request. If the bulletin board subunit determines that the command request does match the access activity, then, in the step **213** the bulletin board subunit sends a notify response to the node address of the schedule entry to notify the requesting control device that the schedule entry has been accessed. If the bulletin board subunit determines at the step **211** that the command request does not match the specified access activity, then the bulletin board subunit returns to the step **203** and continues to monitor the specified data field. Once a notify response has been sent, after an access activity by a competing control device, then the original requesting control device preferably must provide another notify command to the AV/C schedule bulletin board subunit in order to continue to monitor the specified data field.

As described herein, within the preferred embodiment of the present invention, the descriptor mechanism is the AV/C bulletin board subunit and is used to monitor access activity of specified descriptors or entries within the bulletin board subunit.

However, it should be apparent to those skilled in the art that the teachings of the present invention, as described herein, can alternatively be used with any other appropriate descriptor mechanism to monitor access activity of any other appropriate descriptor.

5 The present invention has been described in terms of specific embodiments incorporating details to facilitate the understanding of the principles of construction and operation of the invention. Such reference herein to specific embodiments and details thereof is not intended to limit the scope of the claims appended hereto. It will be apparent to those skilled in the art that modifications can be made in the embodiment chosen for illustration without departing from the spirit and scope of the invention. Specifically, it will be apparent to one of ordinary skill in the art that the device of the present invention could be implemented in several different ways and the architecture, system and method disclosed above are only illustrative of specified embodiments of the invention. Specifically, it will be apparent to those skilled in the art that while the preferred embodiment of the present invention is used with an IEEE 1394-1995 serial bus structure, the present invention could also be implemented on any other appropriate digital interfaces or bus structures, including other or later versions of the IEEE 1394 serial bus. Also, the data frame format described for notify commands utilized in the present invention may have any varying degree of complexity depending on the application at hand.

Claims

What is claimed is:

- 1 1. An architecture for monitoring access of descriptors over a network, the
2 architecture comprising a descriptor mechanism for posting and storing
3 descriptors and corresponding notify command frames submitted from networked
4 control devices, wherein each descriptor comprises a unique node address
5 identifying the control device submitting the descriptor and wherein the
6 corresponding notify command frame instructs the descriptor mechanism to
7 monitor access of data contained within the accessed by a competing control
8 device.
- 1 2. The architecture of claim 1, wherein the descriptor mechanism is a bulletin board
2 subunit and the descriptor is a data entry.
- 1 3. The architecture of claim 2, wherein the bulletin board subunit comprises a
2 resource schedule bulletin board and wherein the data entries are resource
3 schedule entries each comprising a start time, a duration time, and an interval
4 time.
- 1 4. The architecture of claim 3, wherein the resource schedule bulletin board
2 substantially conforms to an AV/C standard protocol.

- 1 5. The architecture of claim 2, wherein the network comprises an IEEE 1394-1995
2 serial bus and wherein data entries are submitted to the bulletin board subunit
3 through the network comprising the IEEE 1394-1995 serial bus.
- 1 6. The architecture of claim 2, wherein the bulletin board subunit stores a node
2 address of the competing control device.
- 1 7. The architecture of claim 6, wherein the node address of the competing control
2 device is posted within node ID data fields of the corresponding notify command
3 frames.
- 1 8. The architecture of claim 2, wherein the bulletin board subunit generates a
2 response data frame and sends the response data frame to a unique node address
3 corresponding to the data entry when the competing control device accesses the
4 data entry.
- 1 9. The architecture of claim 8, wherein the response data frame comprises response
2 data that includes a node address of the competing device.
- 1 10. The architecture of claim 6, wherein the bulletin board subunit records and further
2 stores access activity of a competing control device when the competing control
3 device performs at least one activity selected from a group consisting of reading
4 the data entry, deleting the data entry and modifying a data structure within the
5 data entry.

- 1 11. The architecture of claim 10, wherein activity data is posted within a data field of
2 the corresponding notify command frame.
- 1 12. The architecture of claim 1, wherein the descriptor mechanism stores portions of
2 the descriptor that are accessed by the competing control device.
- 1 13. The architecture of claim 12, wherein the descriptor mechanism stores portions of
2 data that are accessed by the competing control device within a data field of the
3 notify command frame.
- 1 14. The architecture of claim 13, wherein the notify command frame corresponding to
2 the unique node address of the data entry is accessible by the control device
3 identified by the unique node address.
- 1 15. The architecture of claim 1, wherein corresponding notify command frames are
2 submitted after descriptors from networked control devices.
- 1 16. A method of monitoring a descriptor posted over a network from a remote control
2 device, wherein the descriptor comprises a unique node address identifying the
3 remote control device and wherein the descriptor is stored to a descriptor
4 mechanism, the method comprising:

- 5 a. submitting a notify command to the descriptor mechanism, wherein the
6 notify command instructs the descriptor mechanism to monitor the
7 descriptor for access activity by competing control devices; and
8 b. issuing a notify response to the remote control device when a competing
9 device accesses the descriptor.

1 17. The method of claim 16, wherein the descriptor mechanism is a bulletin board
2 subunit and the descriptor is a data entry.

1 18. The method of claim 16, further comprising recording and storing node addresses
2 of the competing device accessing the descriptor.

1 19. The method of claim 18, wherein the node addresses of the competing device is
2 recorded within a data field of the notify command frame.

1 20. The method of claim 18, wherein the notify response comprises data that encodes
2 for the node addresses of the competing device.

1 21. The method of claim 16, wherein the notify response is issued when the
2 competing device performs at least one activity selected from a group consisting
3 of reading the data entry, deleting the data entry and modifying a data structure
4 within the data entry.

- 1 22. The method of claim 16, further comprising recording the access activity of
2 competing devices.
- 1 23. The method of claim 22, wherein the access activity of the competing device is
2 recorded within a data field of the notify command.
- 1 24. The method of claim 17, wherein the bulletin board subunit is an AV/C resource
2 schedule bulletin board and further wherein the data entry is a resource request
3 comprising a start time, a duration time, and an interval time.
- 4 25. The method of claim 16, wherein the notify command frame is submitted after the
5 descriptor.
- 6 26. The method of claim 17, wherein the network substantially complies with a
7 version of an IEEE 1394-1995 standard.
- 1 27. A system for monitoring schedule entries posted to an AV/C resource schedule
2 bulletin board subunit, the system comprising:
3 a) a resource device including a dedicated AV/C resource schedule bulletin
4 board subunit; and
5 b) a plurality of control devices in communication with the resource device
6 and capable of posting the schedule entries to the AV/C bulletin board
7 subunit wherein each of the schedule entries include a unique node address
8 corresponding to the control device posting the request and wherein the

control devices are further capable of submitting notify command frames with schedule entries, wherein each notify command frame identifies a corresponding schedule entry, and further wherein the notify command frame instructs the resource device to monitor access of the schedule entry by the control device.

28. The system of claim 27, wherein the resource device records and stores node addresses of control devices accessing schedule entries after the schedule entries are posted to the resource schedule bulletin board.

29. The system of claim 27, wherein the resource device generates a notify response and sends the notify response to the unique node address of the schedule entry when the schedule entry is accessed by one of the control devices.

30. The system of claim 29, wherein the notify response is sent when the corresponding data entry is read, deleted or otherwise modified by a control device having a node address that does not correspond to the unique node address of the schedule entry.

31. The system of claim 27, wherein the resource device comprises a video receiver and transmitter.

- 1 32. The system of claim 27, wherein the posting device and the resource device are
2 coupled together through a network which substantially complies with a version
3 of an IEEE 1394 standard.

Abstract

The invention is an architecture, a system and a method for monitoring data structures over an IEEE 1394-1995 serial bus network. The data structures are portions of entries that are posted and stored to a descriptor mechanism. Preferably, the entries are schedule entries posted and stored to an AV/C resource schedule bulletin board subunit. According to the invention, a resource request is submitted by a requesting control device to the AV/C resource schedule bulletin board subunit, where request data is stored and posted as a schedule entry. The requesting control device also submits a corresponding notify command data frame to the AV/C bulletin board subunit. The notify command frame instructs the bulletin board subunit to monitor a specified data structure within the schedule entry. Preferably, the notify command frame also specifies the type of access activity that is monitored. When a competing control device performs the specified type of access activity on the specified data structure, the bulletin board subunit sends a notify response frame to the original requesting control device. The notify response frame provides an alert to the original requesting control device that the specified access activity has been performed on the specified data structure by a competing control device. The original requesting control device can then review that accessing activity performed on the data structure and any modifications made to the data structure to determine whether further scheduling is required. Preferably, the access activity of the competing device and modifications made to the schedule entry are stored within the memory unit of the bulletin board subunit to provide a detailed history of the schedule entry.

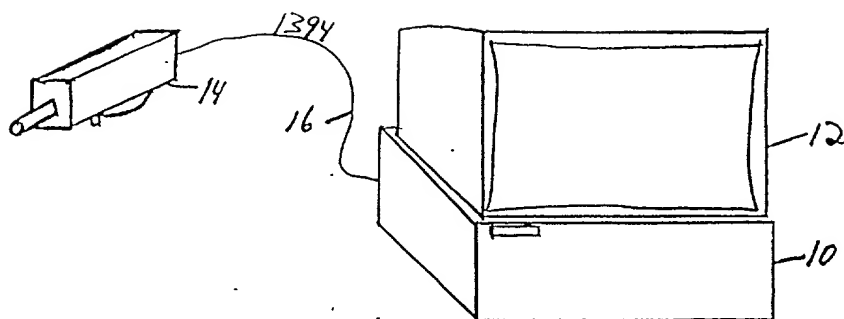
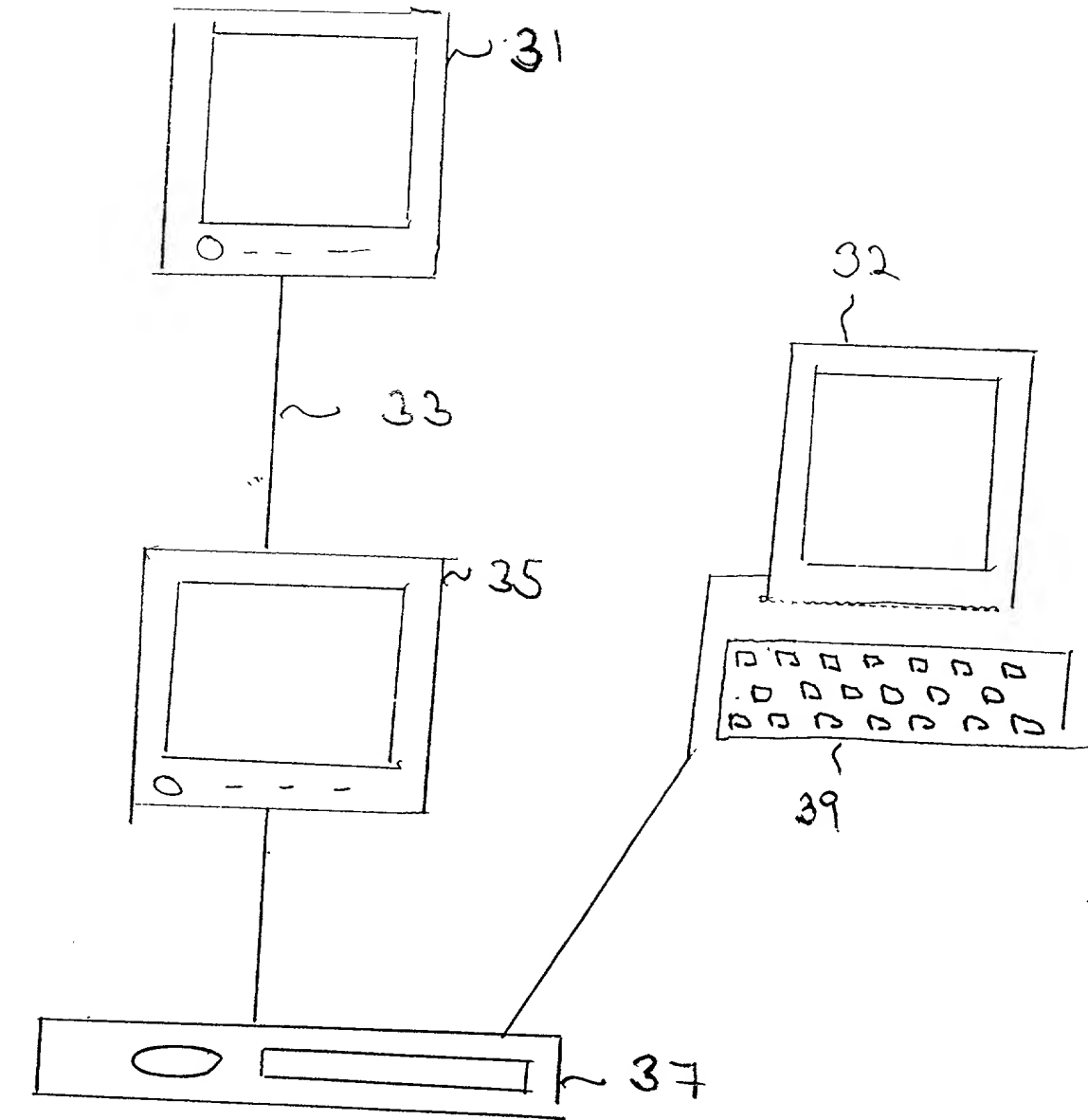


FIGURE 1

Prior Art



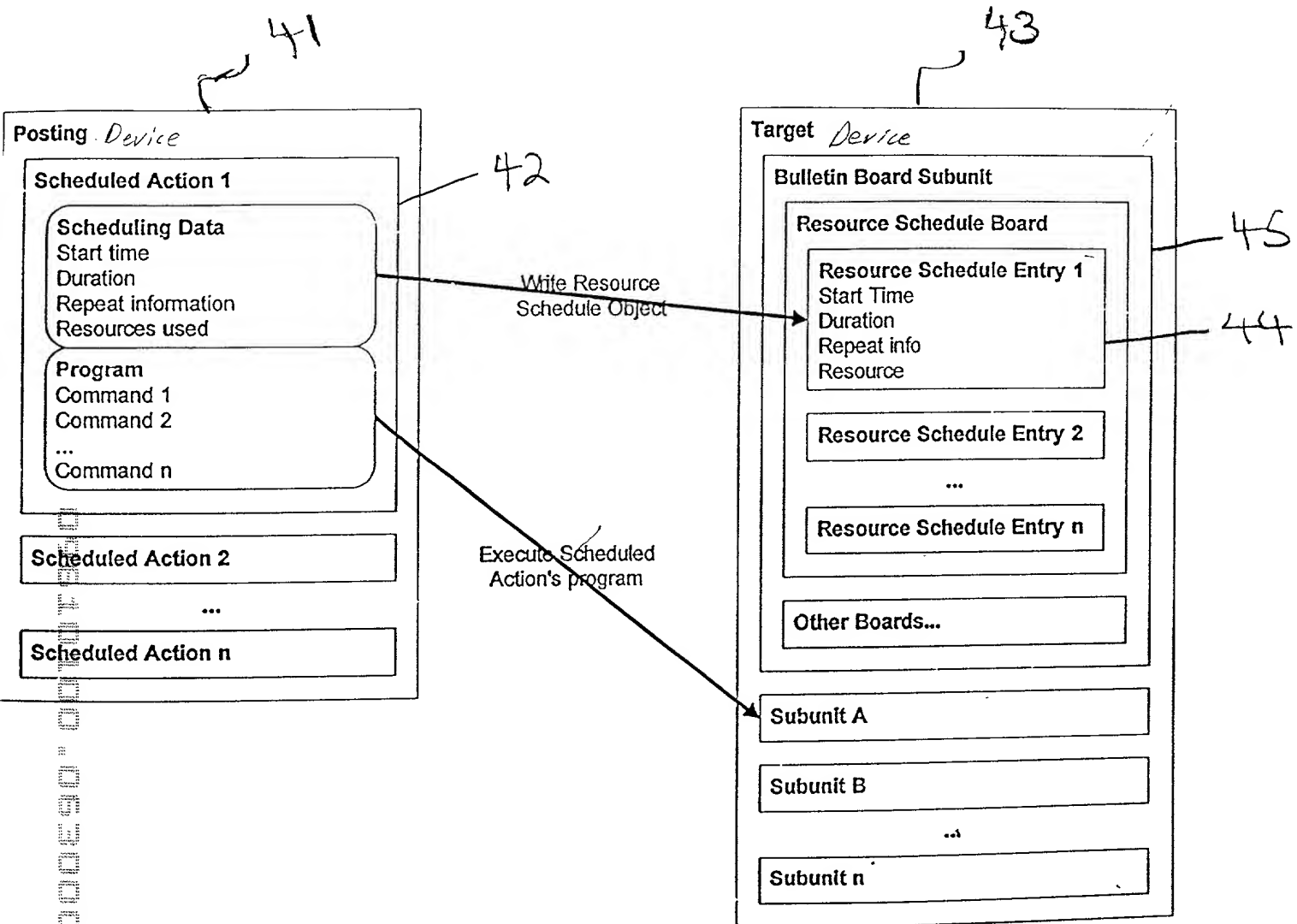


Figure 4

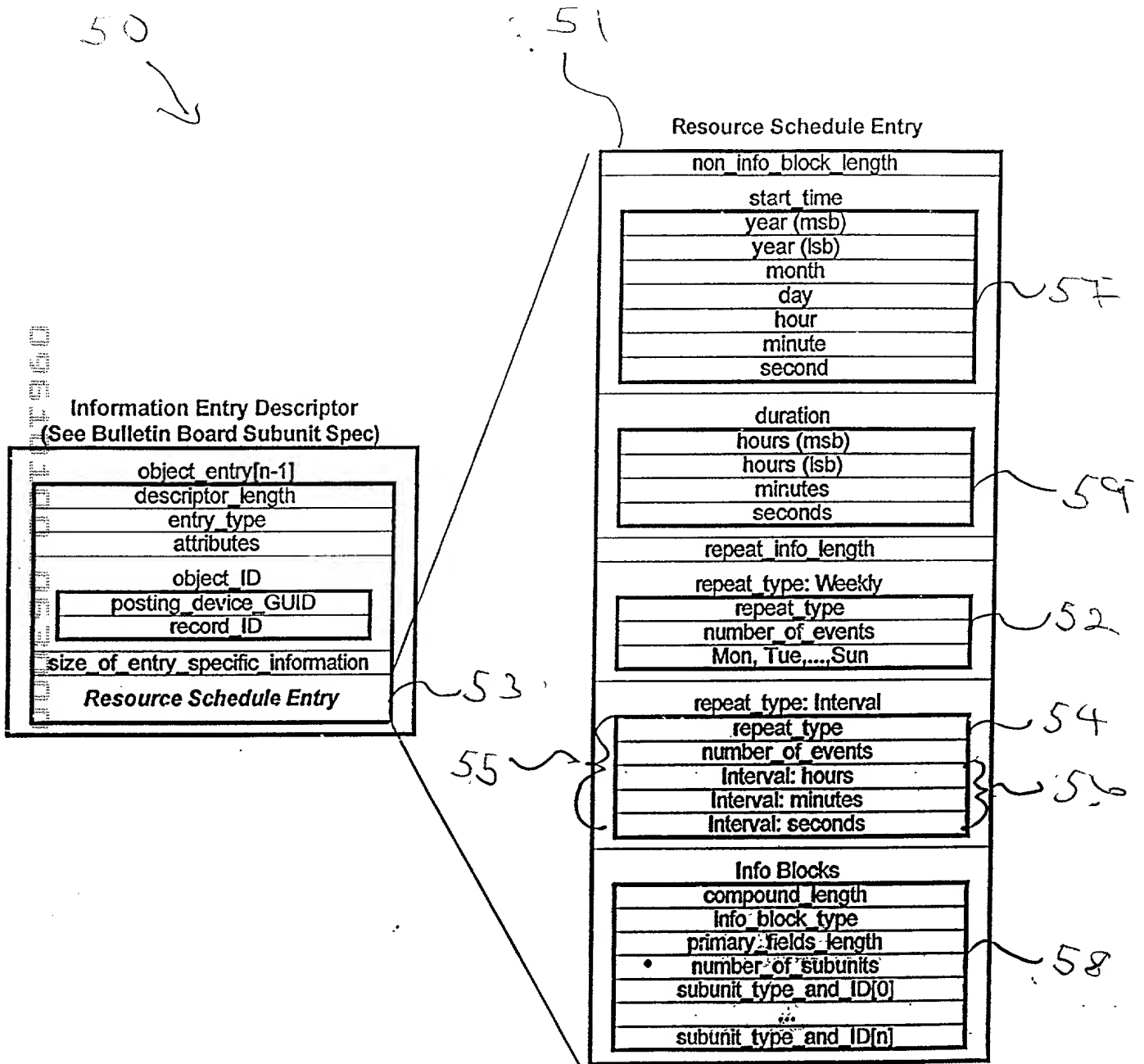


figure 5

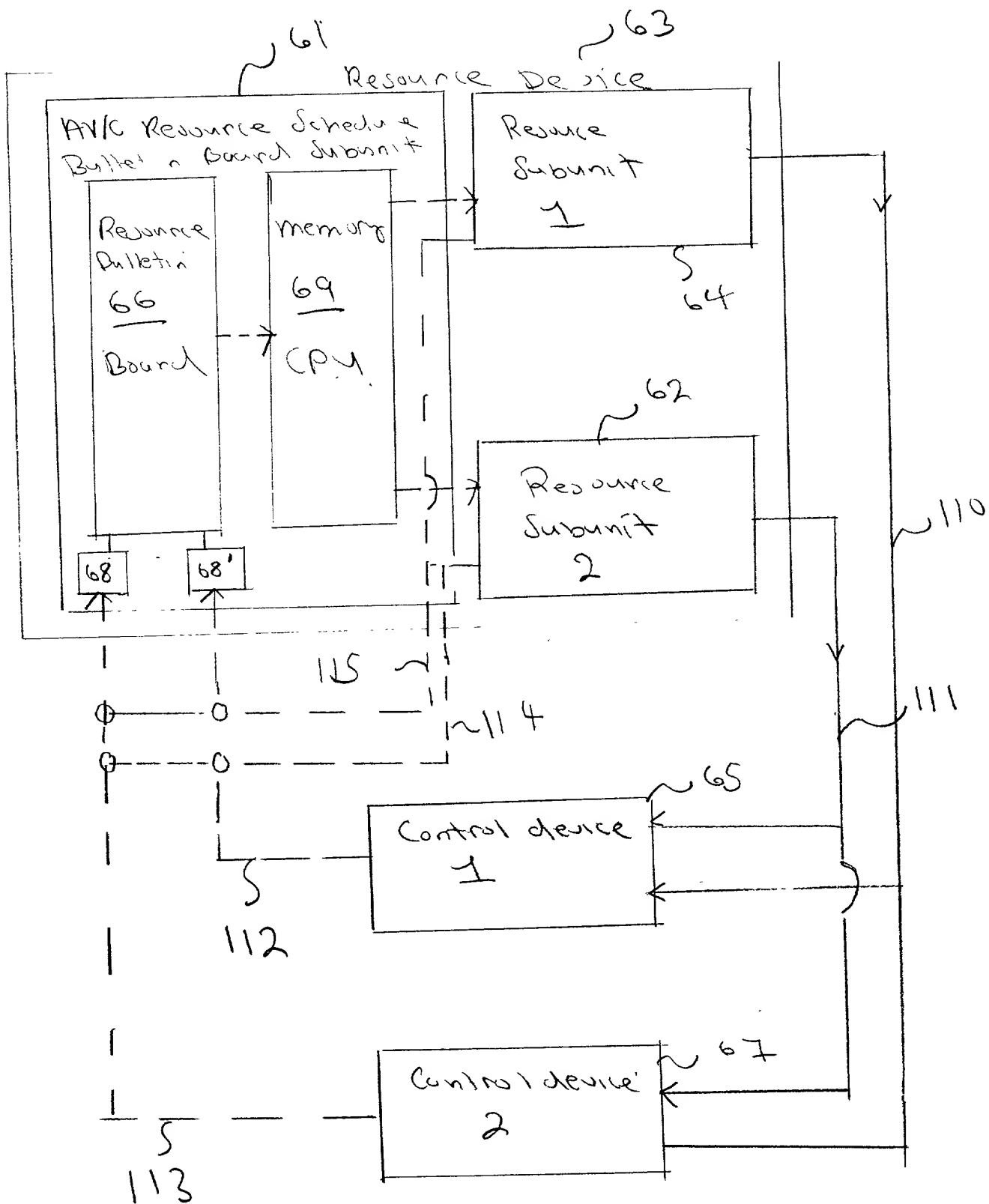


Figure 6

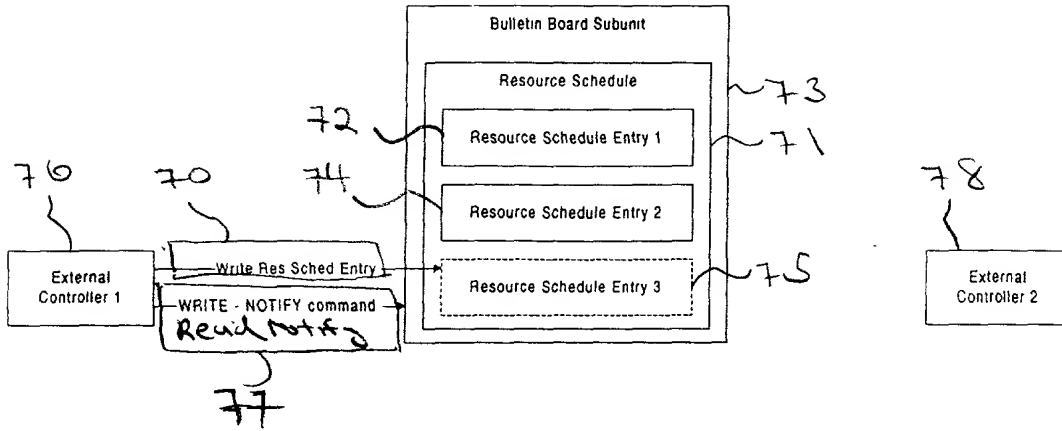


Figure 7a

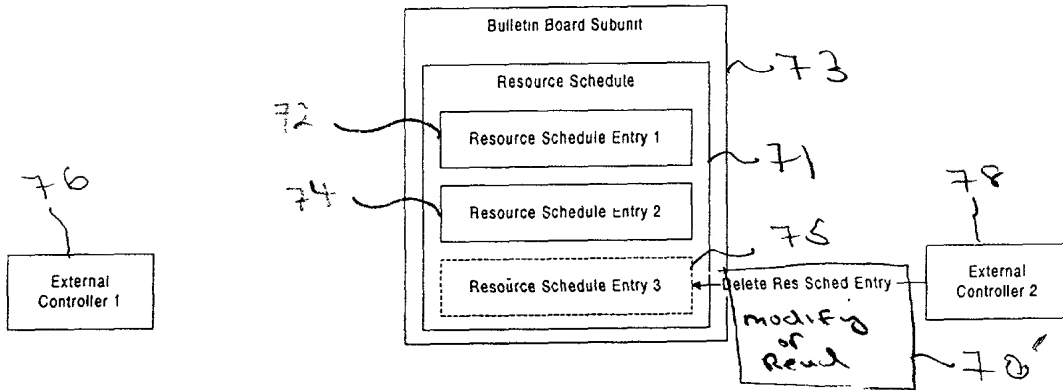


Figure 7b

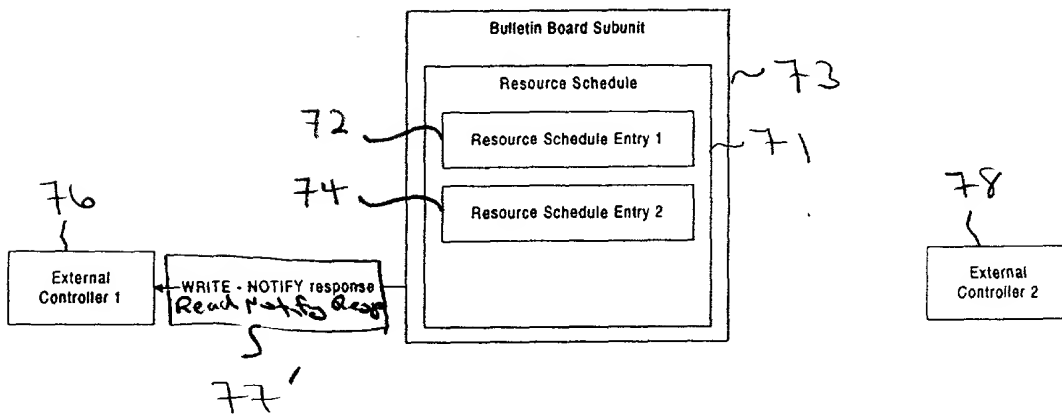


Figure 7c

095410400-063000

	msb						lsb
opcode	READ_DESCRIPTOR (09 ₁₆)						
operand[0]	descriptor_specifier (MSB)						
operand[1]	:						
:	:						
:	descriptor_specifier (LSB)						
:	node_ID (MSB)						
:	(LSB)						
:	data_length (MSB)						
:	(LSB)						
:	address (MSB)						
:	(LSB)						

	msb					lsb
opcode	READ INFO BLOCK (06 ₁₆)					
operand[0]	info_block_reference_path					
operand[1]						
:						
:						
:	node_ID (MSB)					
:	(LSB)					
:	data_length					
:	address					
:						

figure 9b

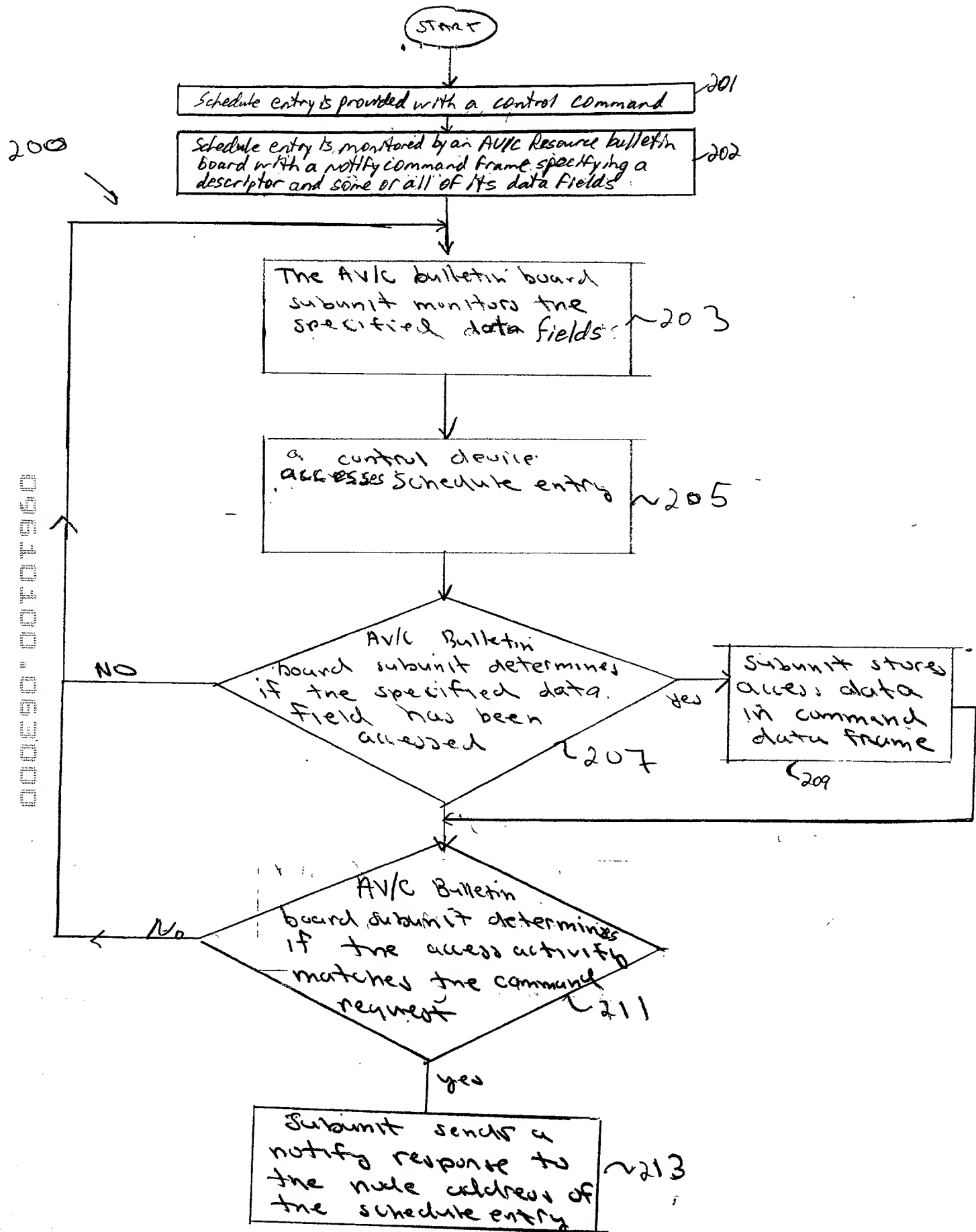


Figure 10

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name. I believe I am an original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **METHOD OF AND APPARATUS FOR COMMUNICATING DATA STRUCTURES BETWEEN DEVICES IN A NETWORKING ENVIRONMENT**. The specification of which is attached hereto. I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claim

Yes No

--	--

Number

Country

Day/Month/Year Filed

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Application Serial No.

Filing Date

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

Application Serial No.

Filing Date

Status: Patented, Pending, Abandoned

I hereby appoint the following as my attorneys with full power of substitution to prosecute this application and transact all business in the Patent and Trademark Office in connection therewith:

Thomas B Haverstock

32,571

Jonathan O. Owens

37,902

Please direct all correspondence regarding this application to the following:

Jonathan O. Owens
HAVERSTOCK & OWENS LLP
260 Sheridan Avenue, Suite 420
Palo Alto, California 94306

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole Inventor: Jon Ebbe Brelín

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